PHARMACEUTICAL AUTOMATION

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INTRODUCTION

AUTOMATION:-

- Means the use of machines and equipments for performing physical and mental operations in a production process in place of human being.
- Is a system of doing work where material handling , production process and product designs are integrated through mechanism of thoughts and efforts to achieve a set regulating & controlling system.
- Is the result of Industrialization , driven by the need to increase productivity & to achieve consistent quality products
- It can be done at various levels of manufacturing system-
  - Handling of raw materials, semi-finished goods or finished goods
  - During production process (efficient machines are used)
  - In Inspection and Quality control operations.

Classification of industrial and laboratory automation-:

- ***PROCESS AUTOMATION-*** deals mainly with handling of raw materials in forms such as liquids or powders. E.g. in oil refinery, oil& gas and chemical industries.

- ***DISCRETE AUTOMATION***- essentially deals with assembly of parts requiring high levels of mechanical motion to produce consumer electronics products and products for the automotive industries.

AUTOMATION IN PHARMACEUTICAL INDUSTRY

- Basic purpose of AUTOMATION in Manufacturing industry is:-
  - To increase Productivity.
  - Improve quality of products & to reduce waste.
  - To reduce the costs.
  - For safe handling of Hazardous substances.
  - To take heavy work from workers.
- *Regulation is a major consideration for Automation as it ensures compliance with safety considerations and guidelines.*

Pharmaceutical industry is hybrid of both Process and discrete manufacturing processes-

- Process Automation system applies in the Primary manufacturing of API (Active Pharmaceutical Ingredients)

- Both Process & Discrete automation are applied in the secondary manufacturing of formulation and packaging (i.e. in compounding , filling , washing, leveling machine and packing.

ADVANTAGES:-

- It provides better quality of goods and service.
- It causes reduction in direct labor costs.
- There is effective control on operation.
- There is greater accuracy, more output and greater speed.
- The production planning and control is to be done in the beginning only
- The working conditions can be improved
- Safety of workers is improved.
- Minimization of wastage
- The service to the consumer is enhanced.
- The quality of product improves as human input is minimized.

***DISADVANTAGES*:-**

- Huge capital investment is required.
- The maintenance cost is very high because maintenance labor of high caliber is required.
- It can create unemployment.
- Continuous power supply is required.
- Large inventories are required.
- Any breakdown , anywhere would lead to complete shut down.
- Requires highly skilled manpower.
- There are restrictions in designing and construction of the building.

AUTOMATIC CONTROLLERS

- Industrial automatic process controller varies from simple on off device to special purpose computing instruments.

- Three general type of controllers-

1) *Self operated controller-*
   - On off controllers
   - Proportional controller

2) *Electronic controller*

3) *Pneumatic controller*

4) *Miscellaneous controller* – Hydraulic, fluidic and special response controller.

1) *Self operated controllers-* Some control systems obtain the power require to operate the error detector and final control element from the controller medium of the process by way of the sensing element .such controller are self operated controller , used for temperature , liquid and pressure controller .

- There are two type of self operated controller –

a) On off controller – in this controller, the amount of control action applied at the process input is either zero or the maximum available.

b) Proportional controllers- The action of a proportional controller is smooth and continuous over the operating range.

For example In a steam-heated process vessel, if the temperature to be controlled increase above the set point, the controller output well increase a proportional amount. This output may reduce the amount of heat being added.

2) ***Electronic controllers-*** Are extensively used for process control . The reason for their increase usage are-

- solid state circuit
- Easier servicing
- Smaller particle size
- can easily be linked with process control computer
- cost completive compare to pneumatic controller
- may be more accurately tuned.

3***) Pneumatic controllers-*** Its basic purpose is to supply compressed air to a pneumatic valve actuator in response to an error signal, based on the deviation of measured variable from the set point.

Computer process control

- In the hierarchy of computer control of a process. Five levels can be identified-
  - Unit operation control
  - Unit process control
  - Plant control
  - Departmental and corporate control level of a company.

- Without computer control at the plant or unit process level, the study state plant operating period tend to become, several days.

Process control computer

1. Analog computer

2. Digital computer

➢*Analog computers*- represents the numbers being manipulated by the magnitude of a physical quantity, such as volts or pressure. Mathematically operations are carried out in a continuous manner.

➢*Digital computers*- are counting device that operates directly on numbers to perform the four fundamental mathematical operation addition, subtraction, multiplication, and division

AUTOMATION IN TABLET MANUFACTURING

Benefits of automation in tablet production-

- Improve material handling.
- Improve specific unit operation- *Unit operations in tablet manufacturing-*
  - Particle size reduction
  - Sieving
  - Mixing.
  - Particle size enlargement.
  - Drying.
  - Compression.
  - Sorting.
  - Coating.
  - Packaging.
- Eliminate or combine processing steps.
- Incorporate automated process control of unit operation and processes.

Examples of material handling improvement

- Granulation and tableting sections of the computer controlled tablet manufacturing process by Merck Sharp & Dohme (MSD) and Eli lily and company.

- Advantages-
  - No human handling of material.
  - The system is built in 3 story building which incorporate vertical drops to utilize gravity whenever possible and uses pumps, vacuum, bucket conveyors to move material upward whenever necessary.

- Processing step combination or elimination in Direct compression -
  - Raw materials.
  - Weighing and measuring (automatic weigher and recording system.)
  - Gravity feeding
  - Compression (high speed rotary press)
  - Aqueous coating (Hi coater).

Wet granulation -:

- Standard processing steps -Load processer Weigh ingredients Mix, mass, agglomerate, dry lubricate Transfer (store),Continuous batch powder mixing and massing equipment.

- E.g. Dionsa mixer & granulator is a high – shear powder mixer and processor

Coating process improvement-:

- Coating of tablets and pills using coating pan is entirely operator dependent.

- *Typical Accela cota*- : for aqueous or solvent film coating. This is a side vented or perforated coating pan.

Advantages:

- One way flow of air through the tablet bed and out the perforation of the pans. These greatly reduces or eliminate the bounce back of atomized spray and particle spray drying of the spray droplets that occurs especially with solvent based coating with conventional pans.

- It benefits coating because the greater air flow through the bed facilitates drying.

- Used for continuous coating of film and sugar systems.


ACCELA-COTA

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